

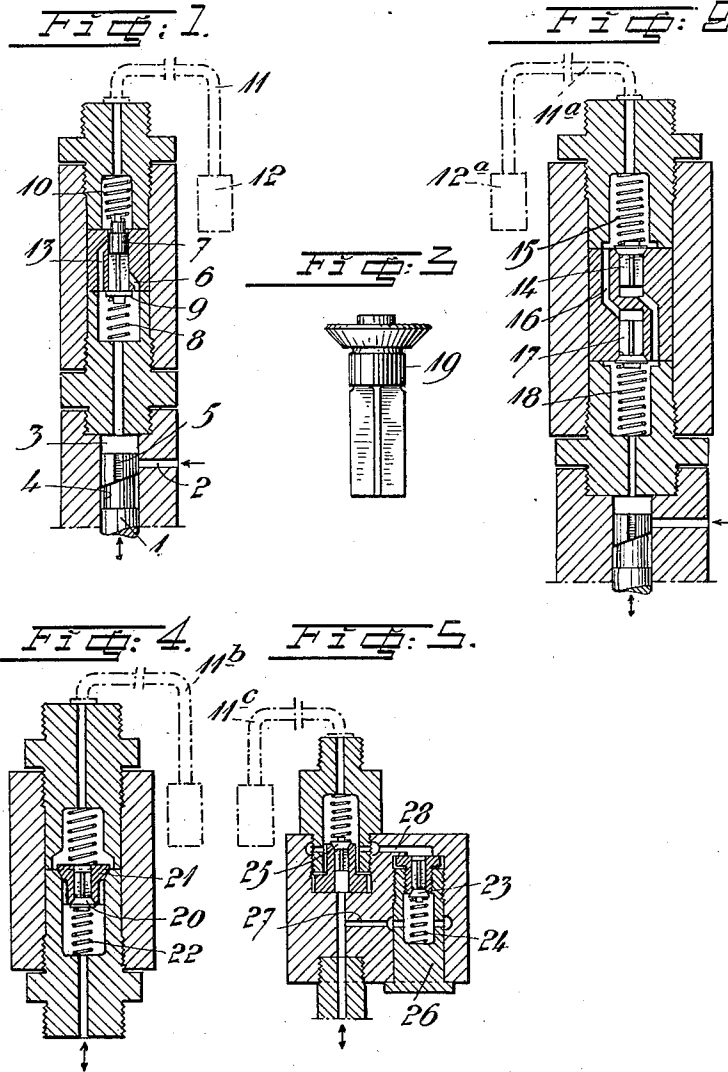
Aug. 24, 1937.

H. G. CAMNER

2,090,781

FUEL PUMP FOR INTERNAL COMBUSTION ENGINES

Filed Oct. 23, 1933



H. G. Camner
INVENTOR

By: Marks & Clerk
ATTYS.

UNITED STATES PATENT OFFICE

2,090,781

FUEL PUMP FOR INTERNAL COMBUSTION
ENGINES

Hilding Gunnar Camner, Saltsjö-Duvnas,
Sweden, assignor to Aktiebolaget Atlas
Diesel, Stockholm, Sweden, a corporation
of Sweden

Application October 23, 1933, Serial No. 694,872
In Sweden July 12, 1933

9 Claims. (Cl. 103—41)

In internal combustion engines of the type, in which the fuel is injected into the combustion chamber or chambers of the working cylinder or cylinders by a pump, consequently without the aid of compressed air, it is difficult or quite impossible especially with very rapidly running engines or with long conduits between the fuel pump and the working cylinders by means of devices hitherto known to reduce the pressure in such a degree, that subsequent dripping of fuel into the working cylinder and the inconveniences resulting therefrom are obviated. This invention relates to means to supply this want in fuel-pump-plants. According to the invention a conduit with spring-loaded valve, a throttling member or the like is connected to the delivery conduit leading from the pump to the working cylinder, which at the unloading of the pump and the closing of the delivery valve of the pump effects a return passage for fuel. At the said device the pressure in the said delivery conduit may be reduced to any desired degree by adapting the tension of the spring belonging to the valve of the return passage or the width of the opening of the throttling member.

In the accompanying drawing some forms of execution of the invention are shown as examples. Fig. 1 shows in a longitudinal section a fuel pump to which the invention is applied, the delivery valve of the said pump being adapted to uncover the return passage for the fuel after the fuel injection has been effected. Fig. 2 shows in a longitudinal section a fuel pump, in which the return passage for the fuel is controlled by a separate spring-loaded valve. Fig. 3 shows in a side view a pressure reducing valve, which may be used in combination with the pump shown in Fig. 2 (and also the pumps shown in Figs. 4 and 5). Fig. 4 shows in a longitudinal section a pump, in which the valve controlling the return passage is located in the delivery valve of the pump. Fig. 5 shows in a longitudinal section a fuel pump with the return passage and its valve provided in a separate chamber located at the side of the delivery valve of the pump.

Fuel is sucked by the pump-plunger 1, Fig. 1, through the channel 2 into the pump chamber 3. As before known, the pump-plunger 1 is provided with a peripheral groove 4 having an upper oblique boundary wall. The said groove 4 communicates with the pump-chamber 3 through a groove 5 extending longitudinally of the plunger 1. Plunger 1 may be rotated by a centrifugal governor or the like in a well known or suitable manner and into different positions adapted to

the load of the engine, so that fuel superfluous for the working stroke of the engine-piston can return to the fuel store through the grooves 5 and 4 and the channel 2.

Fuel passes from the pump-chamber 3 through a channel 6 to the chamber below a plunger-like valve 7, acting as the delivery valve of the pump. At its lower end valve 7 bears against a disc 9 which is acted upon by compressed spring 8. A spring 10 is provided for closing the valve 7. 11 is the conduit leading to the device 12 (indicated only diagrammatically) for injecting the fuel into the working cylinder of the engine. 13 is a channel which communicates with the pump-chamber and the mouth of which is located in the side of the bore in which the plunger valve 7 operates, so that the plunger valve 7 also is adapted to open and close the channel 13.

During the working stroke of the pump-plunger valve 7 is opened by the pressure exerted by the fuel and fuel passes from the pump chamber 3 through channel 6 and conduit 11 to the fuel injecting device 12 and into the combustion chamber of the engine. As the pressure in the fuel pump ceases by the overflow passage 5, 4, 2 being opened, plunger valve 7 is forced backwards by the greater pressure in the conduit 11, so that the latter is connected to the channel 13 and fuel can escape freely. Channel 13 remains uncovered by the valve 7 until the pressure in the delivery-conduit 11 has been so reduced, that it, plus the reaction of spring 10, corresponds to the pressure of the spring 8. Consequently, by providing a spring 8 of suitable tension it is possible to effect such a reduction of the pressure in the conduit 11, as is necessary for preventing subsequent dripping of fuel.

In the form of execution of the invention shown in Fig. 2 the delivery valve of the fuel pump consists of an ordinary conical valve 14 with a spring 15 for shutting the same. The fuel reducing channel 16 is controlled by a conical valve 17, acted upon by a spring 18. In other respects the pump is arranged substantially as the pump shown in Fig. 1 and operates in substantially the same manner as the said pump. During the working stroke of the pump fuel passes through the delivery valve 14 and the delivery conduit 11 to the fuel injecting device 12 and into the combustion chamber of the working cylinder, while valve 17 is held in closed position. As the pump is unloaded, valve 14 is closed by the greater pressure in the conduit 11 and fuel returns through the valve 17, until the pressure in the conduit 11 has been reduced to such a degree, that it

corresponds to the tension of the spring 18. Consequently, also in this case the necessary reduction of the pressure in the conduit 11^a leading to the injecting device may be gained by providing a spring 18 of suitable tension.

The delivery valve of the pump shown in Fig. 2 may be arranged as shown in Fig. 3. According to the figure last mentioned the valve has a cylindrical part 19, adapted to fit tightly in the surrounding wall of the valve, so that the valve when closed and moved further downwards effects an increasing of the volume of the chamber above the valve and fuel in the delivery conduit 11^a is thereby sucked backwards. This results in the reduction of the pressure in the delivery conduit 11^a being accelerated. A similar reduction of the pressure is effected also by the plunger valve 7 shown in Fig. 1.

According to the form of execution of the invention shown in Fig. 4 the return valve 20 and the channel for the same are provided in the delivery valve 21 of the pump 1. The return valve 20 is acted upon by a spring 22 and by adapting the dimensions of the said spring the pressure in the delivery conduit 11^b may be suitably reduced.

Fig. 5 shows a form of execution of the invention according to which the return valve 23 together with its spring 24 is located in a separate casing 26 located at the side of the delivery valve 25 and screwed into the pump casing. A channel 27 connects the casing 26 with the channel located between the pump and the delivery valve 25, and a channel 28 extends from the top side of the valve 23 to the conduit 11^c leading to the injecting device.

The operation of the device shown in Fig. 5 is wholly analogous to the operation described above and the reduction of the pressure in the delivery conduit 11^c may be adjusted by suitably adapting the dimensions of the spring 24.

Also the valves 21 and 25 may, evidently, be arranged like the valve shown in Fig. 3, so that they effect a reduction of the pressure in the delivery conduit while being closed.

I claim:

1. In a fuel injection system for internal combustion engines, a fuel injection device, a fuel pump having a working chamber and a plunger reciprocable therein, a delivery conduit connecting the discharge side of the pump with the injection device and through which fuel is adapted to be forced under pressure during the injection period, a first passage for flow of fuel from the working chamber of the pump to the delivery conduit during the injection period, a second passage for flow of fuel from the delivery conduit to said working chamber, and spring loaded valve means for controlling said passages including two springs tending to maintain the valve means in seated position closing both of said passages, means for suddenly unloading the pump on the working chamber side of said valve means, one of said springs being arranged to permit opening movement of the valve means toward the delivery conduit to open said first passage under the influence of pump pressure during the injection period and the second of said springs being arranged to permit opening movement of said valve means away from said conduit to open said second passage under the influence of the pressure of fuel in the delivery conduit when the pump is unloaded.

2. In a fuel injection system for internal combustion engines, a fuel injection device, a fuel pump having a working chamber, a delivery valve

of the plunger type and spring means for urging said valve to a seated closed position, means for unloading the pump on the working chamber side of the delivery valve to terminate the injection period, a delivery conduit connecting the discharge side of the delivery valve with said injection device and through which fuel is adapted to be forced under pressure during the injection period, a pressure relief passage having an inlet controlled by said valve and connecting said delivery conduit with the working chamber of the pump, said valve having opposed faces both of which are subjected to the pressure in said delivery conduit during the injection period and only one of which is subjected to said pressure when the pump is unloaded and said spring means being arranged to permit said valve to open toward the delivery conduit during the injection period and to permit the valve to move away from the delivery conduit to a position uncovering said inlet under the influence of the pressure of fuel in the discharge conduit when the pump is unloaded.

3. In a fuel injection system for internal combustion engines, a fuel injection device, a fuel pump having a working chamber and a delivery valve of the plunger type, means for unloading the pump on the working chamber side of the delivery valve to terminate the injection period, a delivery conduit connecting the discharge side of the delivery valve with said injection device and through which fuel is adapted to be forced under pressure during the injection period, a first spring and a second spring acting on said valve in opposed directions, said valve having opposed faces both of which are subjected to the pressure in said delivery conduit during the injection period and only one of which faces is subjected to said pressure when the pump is unloaded and said valve being adapted to move from a seated closed position in one direction against the resistance of said first spring due to pump pressure during the injection period and to move from said closed position in the opposite direction against the resistance of said second spring under the influence of the pressure of fuel in said delivery conduit when the pump is unloaded, and a passage for returning fuel from said delivery conduit to the working chamber of the pump controlled by said valve and arranged to be opened by the last mentioned movement of said valve.

4. In a fuel pump including a working chamber, a delivery valve of the plunger type adapted to discharge fuel to a delivery conduit, means for unloading the pump on the working chamber side of the delivery valve, a first spring and a second spring acting on said valve in opposed directions and tending to maintain said valve in a seated closed position, the inlet side of said valve being exposed to pressure of fuel in said pump chamber and the discharge side of the valve being exposed to pressure of the fuel in said delivery conduit, and a fuel return passage providing communication between the discharge side of said valve and said pump chamber, said passage having an inlet located in the valve bore so as to be covered by the valve when the latter is in closed position, said valve being adapted to open toward said delivery conduit against the resistance of said first spring during the injection period and to open in the opposite direction to uncover the inlet of said fuel return passage, when the pump is unloaded, under the influence of the pressure of fuel in the discharge conduit and against the resistance of said second spring.

5. A fuel pump of the plunger type including a

first passage for flow of fuel from the working chamber of the pump to a delivery conduit, a second passage for return flow of fuel from the delivery conduit to said working chamber, a spring loaded delivery valve adapted to control flow through both of said passages, and means for unloading the pump on the working chamber side of the delivery valve to determine the end of the working stroke, said delivery valve being exposed on its inlet side to pressure of fuel delivered through the first mentioned passage and being exposed on its discharge side to the pressure of fuel in the delivery conduit and being movable from a seated closed position to open the second mentioned passage under the influence of the last mentioned pressure when the pump is unloaded.

6. In a fuel injection system for internal combustion engines, an injection device, a fuel pump having a working chamber and a plunger reciprocable therein, a delivery conduit connecting the fuel pump with the injection device and through which fuel is adapted to be forced under pressure during the injection period, said fuel pump having a spring loaded delivery valve adapted to open toward said delivery conduit during the injection period, means for suddenly unloading the pump on the working chamber side of the delivery valve to terminate the injection period, a fuel return passage connecting said delivery conduit and the working chamber of the pump, and a spring loaded return valve adapted to open, when the pump is unloaded, toward the working chamber of the pump under the influence of the pressure of fuel in the delivery conduit between the injection device and said discharge valve.

7. In a fuel injection system for internal combustion engines, an injection device, a fuel pump having a working chamber and a plunger reciprocable therein, a delivery conduit connecting the fuel pump with the injection device and through which fuel is adapted to be forced under pressure during the injection period, said fuel pump having a spring loaded delivery valve of the plunger type adapted to open toward said delivery conduit during the injection period and to close in a direction away from the delivery conduit when the pump is unloaded, whereby to increase the effective volume of the delivery conduit as the valve closes and thereby reduce the pressure therein, means for suddenly unloading the pump on the working chamber side of the delivery valve to terminate the injection period, a fuel return passage providing communication between the delivery conduit and the working chamber of the pump, and a spring loaded return valve control-

ling said conduit and adapted to open, when the pump is unloaded, away from the conduit under the influence of the pressure of fuel within the delivery conduit between the delivery valve and the injection device.

8. In a fuel injection system for internal combustion engines, a fuel injection device, a fuel pump having a working chamber and a fuel supply channel in communication with said chamber, means for suddenly placing the working chamber in communication with said supply channel during the working stroke of the pump to terminate the injection period, a delivery conduit connecting the discharge side of said pump with said injection device, a pressure relief passage connecting said delivery conduit with the pump chamber, delivery valve means controlling said conduit and opening toward the same during the working stroke of the pump, and spring-loaded return valve means controlling said passage, said return valve means being arranged to be opened in a direction away from said delivery conduit when the pump pressure is released to allow fuel to return to the pump chamber and to the fuel supply channel, the spring pressure on said return valve means being adjusted so that upon release of the pressure in the working chamber it permits a quantity of fuel to be discharged from the delivery conduit sufficient to reduce the pressure in said delivery conduit to a value lower than that of the pressure required to effect opening of said fuel injection device.

9. In a fuel injection system for internal combustion engines, a fuel injection device, a fuel pump having a working chamber, a delivery conduit connecting the discharge side of said pump with said device and through which fuel is adapted to be forced under pressure during the injection period, a pressure relief passage in communication with said delivery conduit for returning fuel therefrom to the pump chamber, and means for preventing pressure free return flow from the delivery conduit and said return passage to the working chamber including spring loaded means controlling said passage, and means for suddenly unloading the pump on the working chamber side of the first mentioned means, said spring loaded means being adapted to be opened by the pressure of fuel in the delivery conduit upon unloading of the pump, whereby to prevent production of pressure waves in the fuel delivery conduit of sufficient magnitude to force fuel from the injection nozzle after the termination of the injection period.

HILDING GUNNAR CAMNER.